SSL Postings
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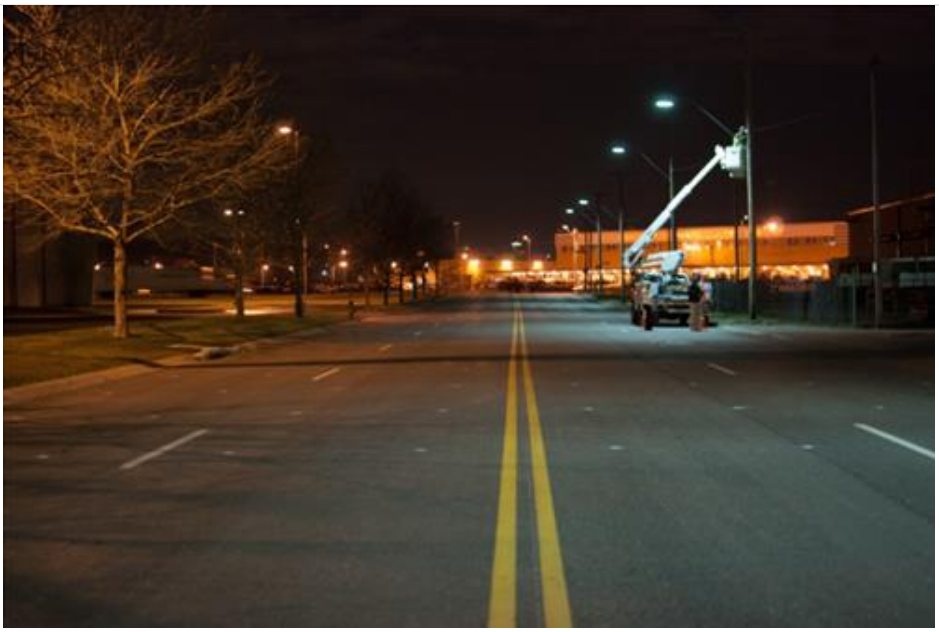
Kansas City Demonstration Highlights Challenges Involved in Evaluating LED Street Lighting Products

The U.S. Department of Energy (DOE) recently published the report from a GATEWAY demonstration of LED street lighting in Kansas City, MO, that was conducted in support of DOE's Municipal Solid-State Street Lighting Consortium (MSSLC). Because it was the first GATEWAY demonstration in recent years in which products were evaluated side-by-side over an extended period of time, it brought to light a number of complexities that are involved in evaluating and deploying LED street lighting products.

Nine different LED street lighting products were installed in February 2011 at nine separate Kansas City sites and were compared to the high-pressure sodium (HPS) luminaires they replaced, which spanned a wide range of wattages (100, 150, 250, and 400W). Illuminance readings were taken at the outset and every 1,000 hours (approximately every three months) thereafter.

As a group, the LED products tended to be slightly more efficacious (an increase of 15 percent in mean efficacy across all products) than their HPS counterparts, but more of their energy savings was from reducing overall light levels and limiting spill light. The reduced light met the desired performance levels in some cases but not in others.

Some of the most interesting findings of the study had to do with performance measurement. For example, for most of the luminaire types, it appears that seasonal variables such as temperature and foliage drive as much as a 20-percent swing in measured illuminance on the ground over the course of a year, and that this



may significantly outweigh any temporal lumen or dirt depreciation, at least during the early stages of product life.

Seasonal factors weren't the only ones that affected performance measurement, however. Even in this carefully designed and maintained location, differences in pole spacing, street width, the amount of spill light, the type and amount of vegetation, and the distance of the houses from the curb were all found to play a part. What's more, readings from the different handheld meters that were used to measure illuminance were also found to vary—not only from brand to brand, but also likely based on changes in the ambient temperature. Such variability in field measurements is not unique to LEDs, of course. But the rapid rise in popularity of LED lighting has led to greater desire for side-by-side comparisons of different types of streetlights, bringing to the fore the many factors affecting measurement accuracy, as we saw in Kansas City.

These variations underscore the importance of taking multiple measurements under different seasonal conditions, and of realizing that field measurements are only one component of a more comprehensive performance assessment. Even with the best design intent, and careful planning and selection, resulting numbers obtained “on the ground” may or may not exactly conform to the original specification, for reasons that go beyond the luminaire. The real world introduces a complex host of combined influences—many of which were encountered in this study and are encountered regularly in field studies of this type.

For a site investigating potential investment in new street lighting products, the best approach is probably to use laboratory-tested performance values for initial design and selection of products, relying on field measurements to then ensure there are no problems or issues present in the resulting installation. Before-and-after comparisons on the same street, with all other variables (such as pole spacing and weather) equal, can provide useful data. But

relying solely on field measurements of products installed in different locations should be avoided, because the measurements at each location can differ significantly due to reasons having little to do with luminaire performance. Field measurements should be considered one component of a much more comprehensive assessment.

Another interesting conclusion of the Kansas City demonstration had to do with design lifetime. The common practice of basing maintained illuminance requirements on end-of-life light levels may not be appropriate for SSL. Using the typical 30-percent lumen depreciation (i.e., L_{70}) output level for the LED product design lifetime means that the resulting illumination requirements are often spanning much greater timeframes than for conventional systems—some in excess of 100,000 hours (in this study, L_{70} projections ranged from 50,000 to 121,000 hours)—so that in effect, the project is designing to meet light levels that may be decades away.

A more practical (not to mention energy-efficient) approach may be to select a point in time beyond which luminaire lifetime projections become increasingly tenuous—say, 15 years—and, using LM-80 projections for each product (along with dirt depreciation and any other relevant light-loss factors), to determine what the likely illumination levels will be at that point. Products offering higher lumen maintenance will have higher illumination values at that evaluation point, but as long as two products are still meeting the *specified* levels, the user can make a purchase decision that's based on price or some other attribute. Note that *not* incorporating L_{70} into the design for products with exceptional lumen maintenance avoids unnecessary over-lighting for most of the early years of their installation, along with corresponding savings in energy use and first cost. In addition, this approach recognizes that other SSL components—such as the power supply and optics—can also influence a product's end of life.

The Kansas City project is one of many GATEWAY demonstrations that showcase high-performance LED products for general illumination. The reports for all of these studies are available for download at www.ssl.energy.gov/gatewaydemos_results.html.

The MSSLC, which sponsored the Kansas City demonstration, will hold its annual meeting September 11 in Phoenix, in conjunction with the Illuminating Engineering Society's Street and Area Lighting Conference. For more information about the MSSLC, please visit www.ssl.energy.gov/consortium.html.

As always, if you have questions or comments, you can reach us at postings@lightingfacts.com.